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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
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ART UNIT	PAPER NUMBER
2644	8

DATE MAILED: 10/27/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/247,826	SHIRAISHI ET AL.	
	Examiner	**Art Unit**	
	Tony M Jacobson	2644	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _13 August 2003_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-3_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-3_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _11 February 1999_ is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _6_.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Allowable Subject Matter

The indicated allowability of claims 1-3 is withdrawn in view of the newly discovered reference(s) to Sato et al. (provided by Applicant in IDS paper 6). Rejections based on the newly cited reference(s) follow.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al. (JP 53002020 A).

3. Because of the minimal nature of the written description and drawings of Sato et al., a number of inconsistencies in that disclosure, and because the signal frequencies in the invention of Sato et al. are described relative to the frequency of a desired signal, whereas Applicant describes signal frequencies relative to an undesired frequency and/or contrived symbols that do not directly relate to actual signals or frequencies in the system and method in a particularly logical manner, the equivalence of Sato et al. to the present invention may not be

immediately apparent. The following description attempts to clarify and simplify the invention of Sato et al. based upon a translation of that document obtained by the Office and the drawings thereof. First, the primary objective of both inventions is to eliminate one or more undesired AM signals that are received along with, and whose spectra partially overlap that of a desired AM signal. Figure E1 below shows the relationship of the received signals according to Fig. 4(a) of the present invention (left) and Fig. 1 of Sato et al. (right). The two drawings illustrate the same situation – a desired signal ("a" in Applicant's drawing and "S_B" in that of Sato et al.) is centered between two partially overlapping signals ("b" and "c" to Applicant, "S_A" and "S_C" to Sato et al.). Adjacent signals are separated from each other by an inter-channel frequency interval ("f_α" to Applicant, "$\Delta\omega$" to Sato et al.). While Applicant generally describes signal frequencies relative to the frequency (f_c) of undesired signal b, located a distance f_α below the desired signal frequency, Sato et al. generally describes signal frequencies relative to the frequency (ω_b or, equivalently, f_b) of the desired signal S_B.

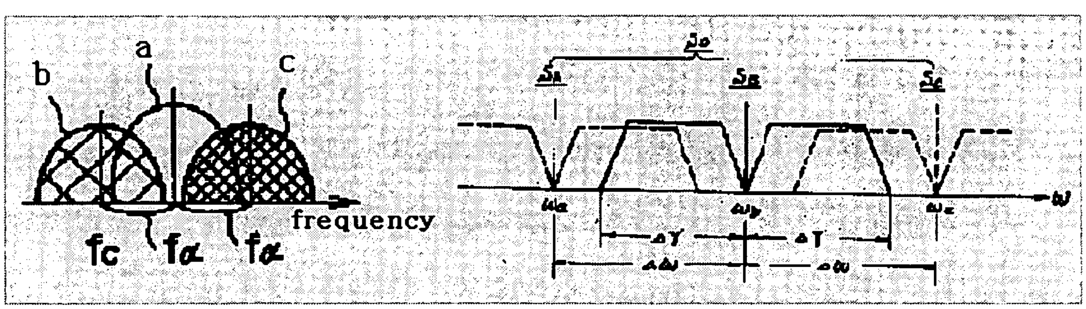

Figure E 1

4. Figure E2 below shows Figure 2 of Sato et al., annotated by the examiner to include symbols within the relevant system blocks to indicate their respective functions (e.g., blocks 1 and 2 represent amplification stages; blocks 10M, 11A, 11B, 14, 15A and 15B represent multipliers [mixers]; blocks 5, 12, and 13 represent oscillators; block 16 represents an addition/subtraction element; and block 3 represents an AM detector).

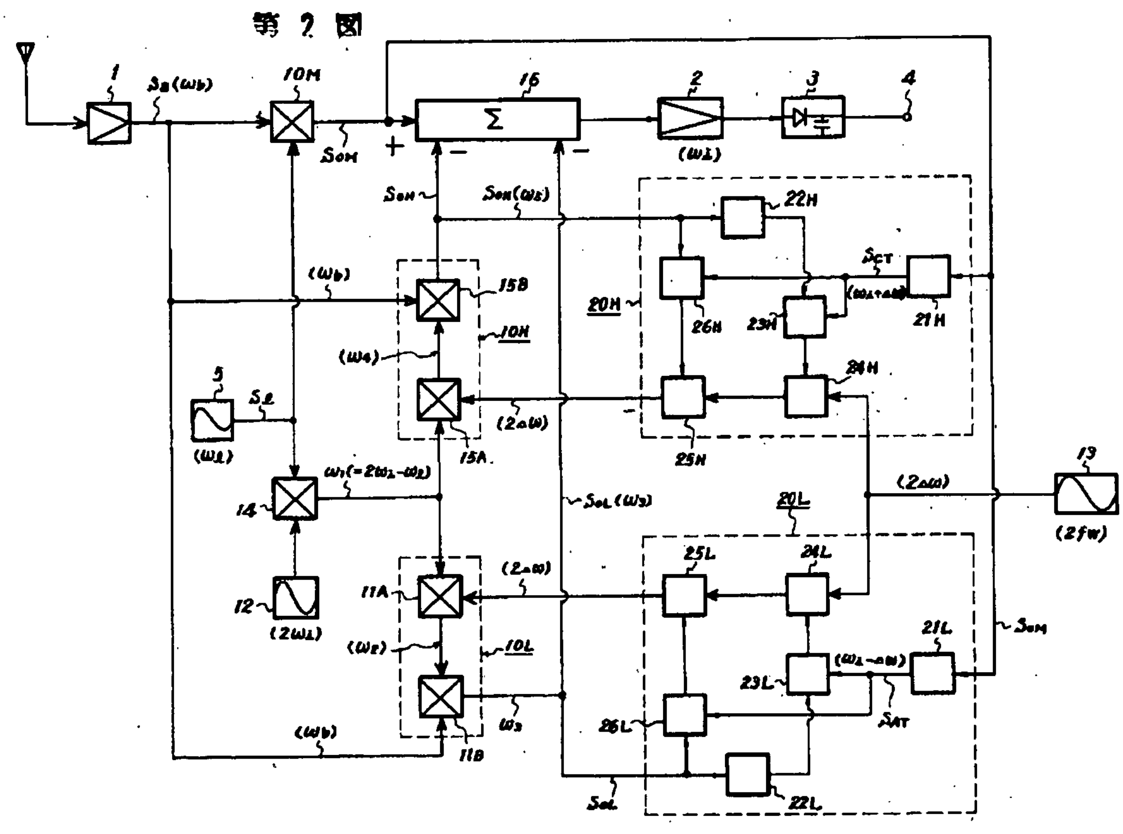

Figure E 2

5. The elements within the boxes 20H and 20L at the right of Figure E2 are not particularly relevant to the claims of the present invention; in the invention of

Sato et al., they adjust the phase of the signal generated by oscillator 13 to ensure proper phase alignment between the three signals (S_{0M}, S_{0H}, and S_{0L}) being subtracted at block 16, as described at pages 10-13 of the translation document. To allow easier understanding of the basic function of this circuit, a simplified version of the diagram with these elements removed is shown in Figure E3, below.

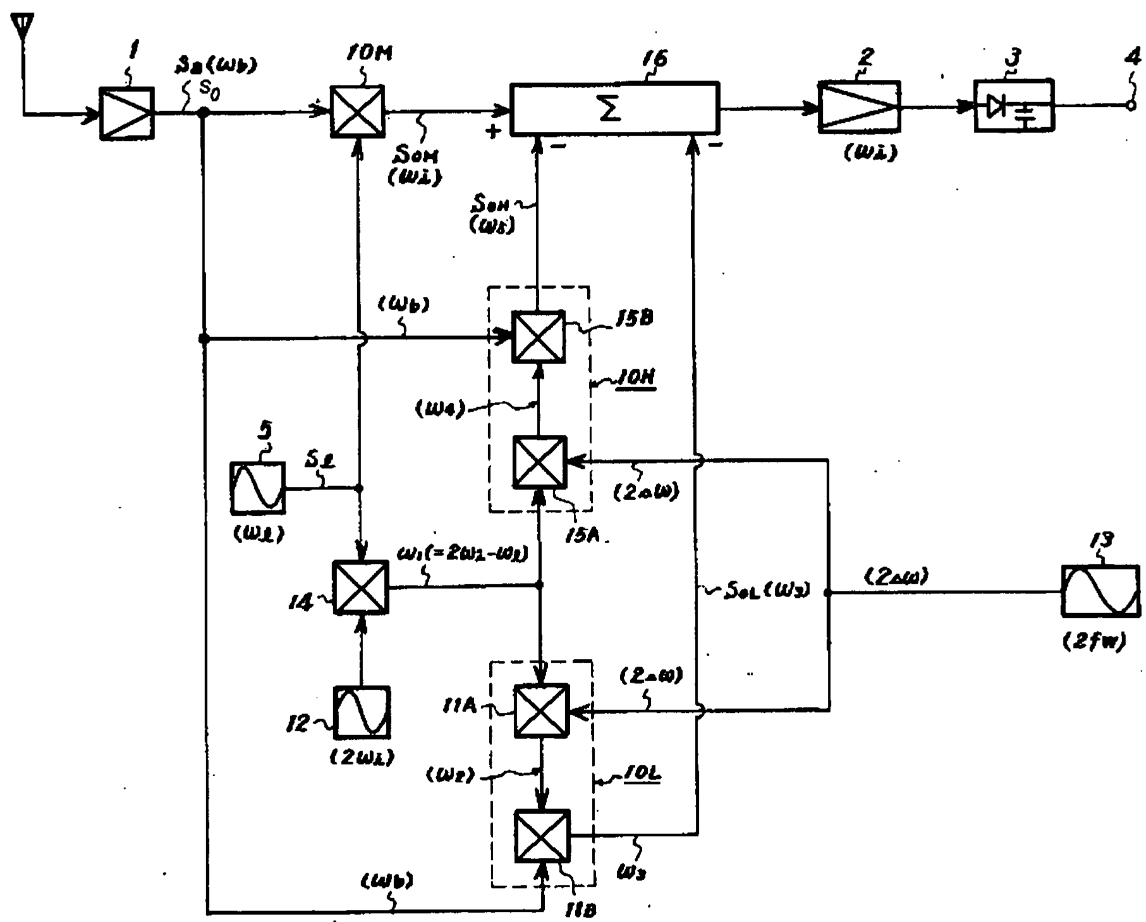

Figure E 3

6. In the diagram of Figure E3, it can be seen that a local oscillation signal S_l having a frequency ω_l is generated at oscillator 5 to be mixed [multiplied] with the

composite radio-frequency (RF) input signal S_0, having a desired signal component S_B centered at a frequency ω_b at multiplier 10M to produce an intermediate-frequency (IF) signal S_{0M}, having the desired signal component centered at frequency ω_i. The local oscillation signal S_l is also mixed at multiplier 14 with a signal having a frequency $2 \cdot \omega_i$, generated at oscillator 12, to form an oscillation signal having a frequency ω_1, which is subsequently multiplied with an oscillation signal having frequency $2 \cdot \Delta\omega$ at multipliers 11A and 15A to form oscillation signals having frequencies ω_2 and ω_4, respectively (where $\Delta\omega$ is the inter-channel frequency interval illustrated in Fig. E1 above, equivalent to f_α in Applicant's disclosure). These oscillation signals, at ω_2 and ω_4, are each subsequently mixed with the original composite RF signal S_0 at multipliers 11B and 15B to produce signals S_{0L} and S_{0H}, having the desired signal component centered at frequencies of ω_3 and ω_5, respectively. The relationship of the frequencies ω_i, ω_3, and ω_5 is $\omega_3 = \omega_i - 2 \cdot \Delta\omega$ and $\omega_5 = \omega_i + 2 \cdot \Delta\omega$, so that the center frequency of the desired signal component in signals S_{0L} and S_{0H} is shifted downward and upward, respectively, in frequency by $2 \cdot \Delta\omega$ with respect to the center frequency of the desired signal component in main signal S_{0M}. The relationships of the center frequencies of these signals are illustrated below in Fig. E4, showing Figs. 3A-3C of Sato et al. (right) and Figs. 4(b)-4(d) of Applicant (left) for comparison.

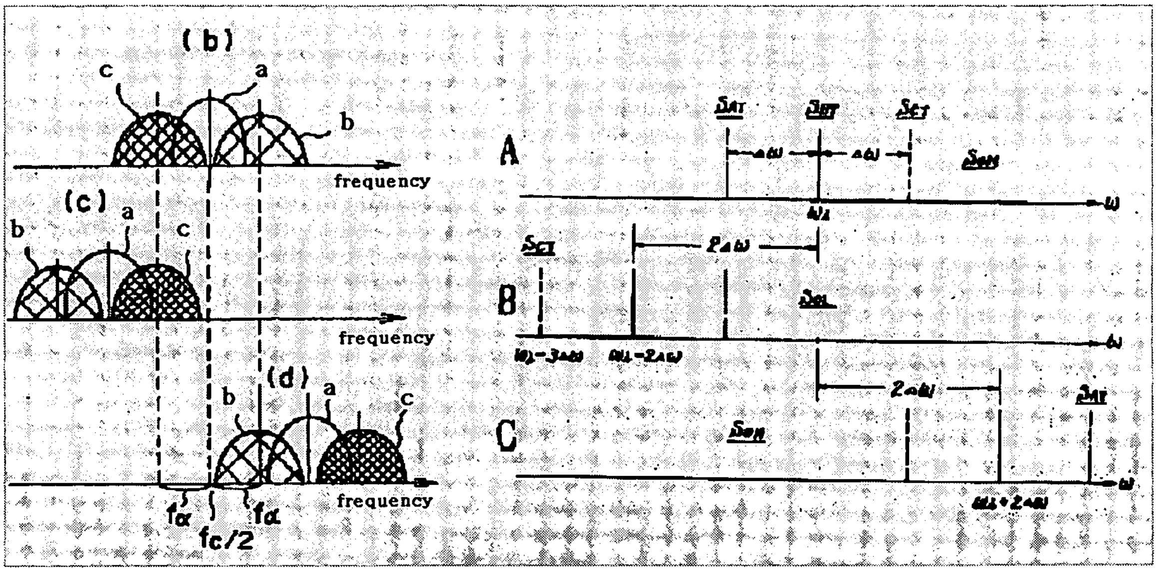

Figure E 4

7. The drawings of Fig. E4 show a main signal at the top graph, frequency-aligned with shifted and spectrally inverted replicas of the main signal at the two lower graphs of each drawing. In both inventions, the two lower signals are subtracted from the upper signal, so that the undesired signal components in the main signal are cancelled in the resultant signal. Figure E5 below shows signal components in the resulting signal (Applicant's Fig. 4(e) at the top, and Fig. 3D of Sato et al. at the bottom), where the main image of the desired signal component is now free of interference. (Sato et al. neglects to show that images of the interfering signal components are still present partially overlapping the lower sideband of the lower image of the desired signal component and the upper sideband of the upper image of the desired signal component, as shown by Applicant; however, this is of no consequence since these image components are subsequently removed by filtering.)

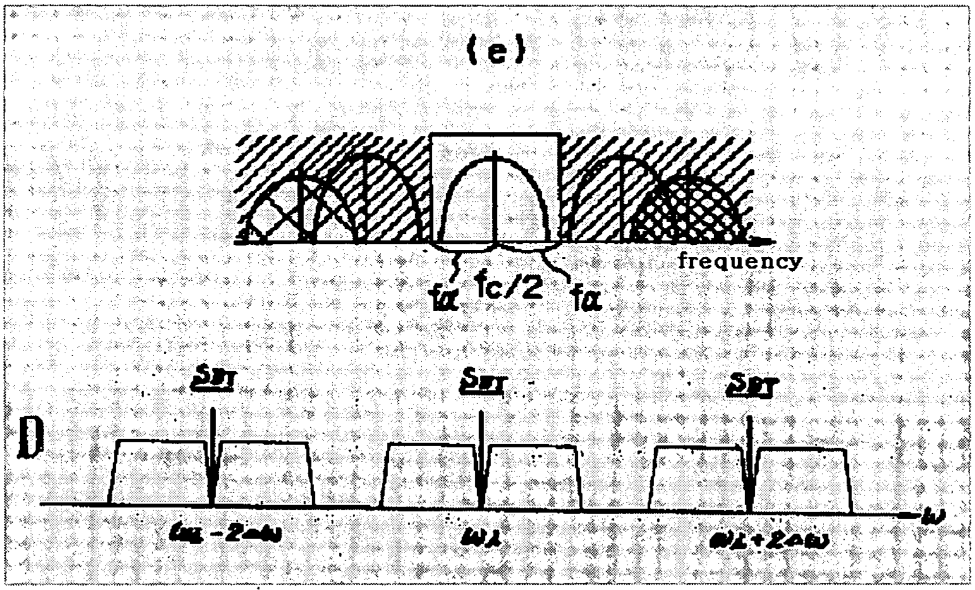

Figure E 5

8. As mentioned above, there are numerous inconsistencies in the disclosure of Sato et al. First, Figs. 3A-C (shown at the right-hand side of Fig. E4, above) show that the signals S_{0L} and S_{0H}, output from multipliers 11B and 15B respectively, are spectrally inverted. (i.e., interfering signal component S_C (S_{CT}), which is at a higher frequency than the desired signal component, S_B, in the original signal [shown above at the right-hand side of Fig. E1], is located at a lower frequency than the desired signal component, S_B (S_{BT}), in signals S_{0L} and S_{0H}; conversely for interfering signal component S_A [S_{AT}].) Such spectral inversion of the original signal S_0 to form signals S_{0L} and S_{0H} would require high-side injection (multiplying/mixing the composite signal S_0 with an oscillation signal having a frequency higher than the frequency of composite signal S_0 and low-

pass filtering the result to isolate the difference-frequency component) at multipliers 11B and 15B to produce in each case a respective difference-frequency signal that is spectrally inverted and shifted to be centered at a respective desired frequency. This is supported in the translation document at page 7, lines 16-19 and at page 8, lines 11-14; however, Sato et al. discloses at page 7, lines 1-7, and Equations 3 and 5 that signals S_{0L} and S_{0H} (having the desired signal component S_B at frequencies of ω_3 and ω_5, respectively) are formed as sum-frequency components of the outputs of multiplier/mixers 11B and 15B (presumably by appropriately high-pass filtering the outputs of multipliers 11B and 15B, as is conventional in the art), which cannot produce the required spectral inversion. Also, if sum frequencies are taken from these mixers/multipliers, the resulting signals S_{0L} and S_{0H} will necessarily have the desired signal component at frequencies that are greater than the frequency of the original composite RF signal S_0 since adding any real (positive) frequency to the frequency (spectrum) of S_0 at mixers 11B and 15B must result in a higher-frequency result. The disclosure of Sato et al. generally discloses that the frequency of the signal S_{0M} is reduced from that of signal S_0 (page 3, lines 18-19 ["1 is a high-frequency amplifier, 2 is a medium-frequency amplifier"]; page 4, lines 1-11 ["medium frequency"]); and according to Fig. 3 (Fig. E4-right, above) signal S_{0L} contains the desired signal component at a frequency $2 \cdot \Delta\omega$ less than the frequency of that component in the "medium frequency" signal S_{0M}. Thus, contrary to the written description at page 7, lines 3-7 and Equations 3 and 5, ω_3 and ω_5 cannot be formed as sum frequencies from the product of signal S_0

(having desired signal component S_B at frequency ω_b) and any other signal.

9. One of ordinary skill in the art would recognize possible solutions to this inconsistency to make the system of Sato et al. operable. A first solution is to provide high-side injection at multipliers 11B and 15B (including low-pass filtering the multiplier outputs to isolate the difference-frequency components, as was well known in the art). In order to correctly produce signals S_{0L} and S_{0H}, having the desired signal component located at frequencies $\omega_3 = \omega_i - 2 \cdot \Delta\omega$ and $\omega_5 = \omega_i + 2 \cdot \Delta\omega$, respectively (as indicated in Figs. 3A-C [Fig. E4-right, above]; at page 7, lines 11-15; page 7, line 20 – page 8, line 2; and Equations 3 and 5), the oscillation signals output by multipliers 11A and 15A must have frequencies of $\omega_2 = \omega_b + \omega_i - 2 \cdot \Delta\omega$ and $\omega_4 = \omega_b + \omega_i + 2 \cdot \Delta\omega$, respectively. The translation document indicates at page 6, line 20 –page 7, line 3 and Equations 2 and 4 that mixer 11A produces an output oscillation signal having frequency ω_2 by forming a difference frequency $\omega_2 = \omega_1 - 2 \cdot \Delta\omega$ (by multiplying the oscillation signal at frequency ω_1 output by multiplier 14 with the oscillation signal at frequency $2 \cdot \Delta\omega$ generated by oscillator 13 and appropriately low-pass filtering the result, as is conventional in the art) and that mixer 15A produces an output oscillation signal having frequency ω_4 by forming a sum frequency $\omega_4 = \omega_1 + 2 \cdot \Delta\omega$ (by multiplying the oscillation signal at frequency ω_1 output by multiplier 14 with the oscillation signal at frequency $2 \cdot \Delta\omega$ generated by oscillator 13 and appropriately high-pass filtering the result, as is conventional in the art). Thus, the oscillation signal output by mixer 14 must have a frequency $\omega_1 = \omega_b + \omega_i$ (so that $\omega_2 = \omega_1 - 2 \cdot \Delta\omega =$

$\omega_b + \omega_i - 2 \cdot \Delta\omega$ and $\omega_4 = \omega_1 + 2 \cdot \Delta\omega = \omega_b + \omega_i + 2 \cdot \Delta\omega$, as determined above). Also, because mixer 10M must shift the desired signal component at ω_b in the composite input signal S_0 to a lower "medium" frequency (page 4, lines 5-7 of translation), ω_i, in signal S_{0M} without inverting the spectrum of that signal (Fig. E4-right-A, above), the oscillation signal S_l must have a frequency $\omega_l = \omega_b - \omega_i$. Solving this last equation for ω_b gives $\omega_b = \omega_l + \omega_i$; and substituting this result into the required equation for ω_1 gives $\omega_1 = 2 \cdot \omega_i + \omega_l$. Since multiplier 14 already has the required input signals at frequencies ω_l and $2 \cdot \omega_i$, it becomes apparent that mixer 14 must form the sum frequency of its input signal frequencies, contrary to the indication of Fig. 2 of Sato et al. (Fig. E3, above); page 6, lines 20-21; and equation 1 of page 7. In summary, as described above, a first solution to the inconsistencies of Sato et al., consists of high-pass filtering the output of multiplier 14, rather than low-pass filtering, to obtain an oscillation signal having a frequency (ω_1) equal to the sum of the frequencies of the input signals (ω_l and $2 \cdot \omega_i$) and low-pass filtering the signals output by multipliers 11B and 15B to obtain shifted and spectrally-inverted signals S_{0L} and S_{0H} with the desired signal component located at $\omega_3 = \omega_i - 2 \cdot \Delta\omega$ and $\omega_5 = \omega_i + 2 \cdot \Delta\omega$, respectively, according to Figs. 3B and 3C (Fig. E4-right, above).

10. One of ordinary skill in the art might also seek other solutions to the inconsistencies of the disclosure of Sato et al. As another possible solution, instead of inverting the spectra of the signals S_{0L} and S_{0H}, as indicated by Figs. 3A-C of Sato et al. (Fig. E4, above), the spectrum of signal S_{0M} could by inverted

by performing a high-side injection at mixer 10M (setting ω_l equal to $\omega_b + \omega_i$) and low-pass filtering the result of the multiplication to obtain $\omega_i = \omega_l - \omega_b$). This solution would result in the frequency of the oscillation signal output by multiplier 14 actually having a frequency of $\omega_1 = \omega_l - 2 \cdot \omega_i$ (which is the absolute value of $2 \cdot \omega_i - \omega_l$ when $\omega_l > 2 \cdot \omega_i$, and which would therefore be produced by low-pass filtering the product signal produced by multiplier 14 without any associated structural modification), since ω_i must be less than ω_b to convert signal S_0 to signal S_{0M} at a reduced frequency as indicated at page 3, lines 18-19 and page 4, lines 1-7). This solution would also require forming signals S_{0L} and S_{0H} as difference frequencies instead of sum frequencies (with inherent low-pass filtering of the multiplier output to remove the sum frequency components), forming the signal output by mixer 11A as a sum frequency, instead of a difference frequency, and forming the signal output by mixer 15A as a difference frequency, instead of a sum frequency. (Alternatively, instead of taking a sum frequency at mixer 11A and a difference frequency at mixer 15A, this portion of the circuit could be left unaltered and the functions of blocks 10L and 10H interchanged, so that 10L now produces a signal with the desired component at $\omega_3 = \omega_i + 2 \cdot \Delta\omega$, instead of $\omega_3 = \omega_i - 2 \cdot \Delta\omega$; and block 10H now produces a signal with $\omega_5 = \omega_i - 2 \cdot \Delta\omega$, instead of $\omega_5 = \omega_i + 2 \cdot \Delta\omega$, ultimately producing the same result.)

11. Having addressed the inconsistencies in the disclosure of Sato et al. to the extent necessary to make the invention functional, the block diagram of Fig. 2

can be further simplified to allow easier comparison with the claimed invention. Figure E6 shows the block diagram of Fig. 2 with the series of mixers and oscillators for generating the oscillation signals at frequencies ω_2 and ω_4 replaced with simple oscillators generating these signals directly.

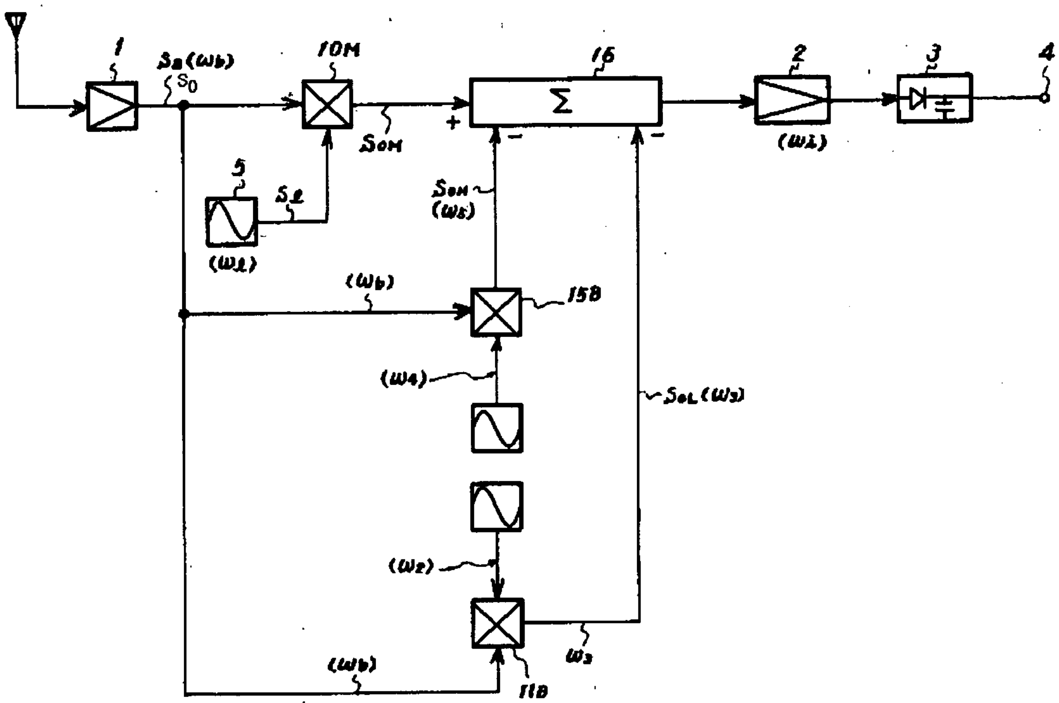

Figure E 6

12. For easier comparison against the claims of the present invention, the oscillation signal frequencies ω_l, ω_2, and ω_4 will be redefined in terms of the frequency of an undesired signal component in the composite input signal S_0. Since the desired signal component S_B is centered at a frequency of ω_b in the input signal, undesired signal components S_A and/or S_C (according to the disclosure of Sato et al.) will be centered at frequencies of $\omega_b \pm \Delta\omega$ (Fig. E1,

above). Now, the first solution to the inconsistencies of the disclosure of Sato et al. (described above) with an undesired interfering AM signal centered at $\omega_{u+} = \omega_b + \Delta\omega$ is considered (the symbols ω_{u+} and ω_{u-} are created and defined here for convenience by the examiner to identify the frequencies of the undesired interfering signals S_C and S_A, respectively, disclosed by Sato et al.):

$$
\begin{aligned}
&\textit{given}:\\
&\omega_{u+} = \omega_b + \Delta\omega\\
&\omega_l = \omega_b - \omega_i\\
&\omega_2 = \omega_b + \omega_i - 2\cdot\Delta\omega\\
&\omega_4 = \omega_b + \omega_i + 2\cdot\Delta\omega,
\end{aligned}
$$

$$
\begin{aligned}
&\omega_l - \omega_{u+} = \omega_b - \omega_i - (\omega_b + \Delta\omega)\\
&= -(\omega_i + \Delta\omega)\\
&\omega_2 - \omega_{u+} = \omega_b + \omega_i - 2\cdot\Delta\omega - (\omega_b + \Delta\omega)\\
&= \omega_i - 3\cdot\Delta\omega\\
&\omega_4 - \omega_{u+} = \omega_b + \omega_i + 2\cdot\Delta\omega - (\omega_b + \Delta\omega)\\
&= \omega_i + \Delta\omega
\end{aligned}
$$

13. Next, the case of an undesired interfering AM signal centered at $\omega_{u-} = \omega_b - \Delta\omega$ according to the first solution is considered:

$$
\begin{aligned}
&given:\\
&\omega_{u-} = \omega_b - \Delta\omega\\
&\omega_l = \omega_b - \omega_i\\
&\omega_2 = \omega_b + \omega_i - 2\cdot\Delta\omega\\
&\omega_4 = \omega_b + \omega_i + 2\cdot\Delta\omega,
\end{aligned}
$$

$$
\begin{aligned}
&\omega_l - \omega_{u-} = \omega_b - \omega_i - (\omega_b - \Delta\omega)\\
&= -(\omega_i - \Delta\omega)\\
&\omega_2 - \omega_{u-} = \omega_b + \omega_i - 2\cdot\Delta\omega - (\omega_b - \Delta\omega)\\
&= \omega_i - \Delta\omega\\
&\omega_4 - \omega_{u-} = \omega_b + \omega_i + 2\cdot\Delta\omega - (\omega_b - \Delta\omega)\\
&= \omega_i + 3\cdot\Delta\omega
\end{aligned}
$$

14. Now, the second solution to the inconsistencies of Sato et al. (described above) with an undesired interfering AM signal centered at $\omega_{u+} = \omega_b + \Delta\omega$ is considered:

$$
\begin{aligned}
&given:\\
&\omega_{u+} = \omega_b + \Delta\omega\\
&\omega_l = \omega_b + \omega_i\\
&\omega_2 = \omega_b - \omega_i + 2\cdot\Delta\omega\\
&\omega_4 = \omega_b - \omega_i - 2\cdot\Delta\omega,
\end{aligned}
$$

$$
\begin{aligned}
&\omega_l - \omega_{u+} = \omega_b + \omega_i - (\omega_b + \Delta\omega)\\
&= \omega_i - \Delta\omega\\
&\omega_2 - \omega_{u+} = \omega_b - \omega_i + 2\cdot\Delta\omega - (\omega_b + \Delta\omega)\\
&= -(\omega_i - \Delta\omega)\\
&\omega_4 - \omega_{u+} = \omega_b - \omega_i - 2\cdot\Delta\omega - (\omega_b + \Delta\omega)\\
&= -(\omega_i + 3\cdot\Delta\omega)
\end{aligned}
$$

15. Finally, the case of an undesired interfering AM signal centered at $\omega_{u-} = \omega_b - \Delta\omega$ for this second solution is considered:

$$
\begin{aligned}
&\textit{given}:\\
&\omega_{u-} = \omega_b - \Delta\omega\\
&\omega_l = \omega_b + \omega_i\\
&\omega_2 = \omega_b - \omega_i + 2\cdot\Delta\omega\\
&\omega_4 = \omega_b - \omega_i - 2\cdot\Delta\omega,
\end{aligned}
$$

$$
\begin{aligned}
&\omega_l - \omega_{u-} = \omega_b + \omega_i - (\omega_b - \Delta\omega)\\
&= \omega_i + \Delta\omega\\
&\omega_2 - \omega_{u-} = \omega_b - \omega_i + 2\cdot\Delta\omega - (\omega_b - \Delta\omega)\\
&= -(\omega_i - 3\cdot\Delta\omega)\\
&\omega_4 - \omega_{u-} = \omega_b - \omega_i - 2\cdot\Delta\omega - (\omega_b - \Delta\omega)\\
&= -(\omega_i + \Delta\omega)
\end{aligned}
$$

16. It would have been obvious to one of ordinary skill in the art at the time the present invention was made to make either of the above-described modifications to the system and method of Sato et al. in order to produce a properly functioning embodiment of the invention. Now the claims of the present invention are considered in view of these modified embodiments.

17. Regarding claim 1, Sato et al. discloses in Fig. 2 an AM receiver that, modified as described above in regard to the first solution, in normal operation performs a method of removing AM neighboring interference of an AM receiver, comprising the steps of:

multiplying (at multiplier 15B) an AM modulation wave (S_B) to be received by a signal (output of multiplier 15A) having a frequency ($\omega_4 = \omega_b + \omega_i + 2\cdot\Delta\omega$)

higher by a predetermined frequency ($\omega_i + \Delta\omega$) than a carrier frequency ($\omega_{u+} = \omega_b + \Delta\omega$) of an interference AM modulation wave (S_C of Fig. 1 [Fig. E1, above]) causing interference and by another frequency ($\omega_l = \omega_b - \omega_i$) lower by the predetermined frequency ($\omega_i + \Delta\omega$) than the carrier frequency ($\omega_{u+} = \omega_b + \Delta\omega$) of the interference AM modulation wave (see the equations of paragraph 12, above);

removing high frequency components from each of [the] two multiplied signals to derive two signals (although Sato et al. does not explicitly disclose a low-pass filter at the output of multiplier 15B, page 11, lines 13-15 indicate that low-pass filtering is performed on the output of multiplier 23L, but not illustrated, filtering is inherently necessary to isolate the desired portion of the product [sum or difference component], and low-pass filtering in particular is necessary to isolate the difference-frequency component in order to produce a working embodiment as described above; the same applies to the output of multiplier 10M), and subtracting (at 16) one of the two derived signals (S_{0H}) from the other (S_{0M}) to obtain a subtraction signal; and

removing high frequency components higher than a predetermined frequency from the subtraction signal (intermediate-frequency amplifiers such as "medium frequency amplifier" 2 typically comprise bandpass filtering to remove frequencies higher and lower than a desired frequency) to obtain the AM modulation wave desired to be received.

Again, it would have been obvious to one of ordinary skill in the art at the time the present invention was made to modify the system of Sato et al. as described above with regard to the first solution to the inconsistencies and omissions in the disclosure of Sato et al. utilizing knowledge that was common in the art, and to provide bandpass filtering in the medium frequency amplifier (2) as was conventional in the art at the time the present invention was made, in order to produce a functional embodiment of the invention of Sato et al. (It is noted that the second solution described above similarly meets the limitations of this claim, and both solutions do so for an interference signal that is located at a frequency either above or below the frequency of the desired signal.)

18. Regarding claim 2, the circuit of Sato et al., modified according to the first solution described above to correct the inconsistencies and omissions of that disclosure (Fig. E3, above), constitutes an AM neighboring interference removing circuit for removing AM neighboring interference of an AM receiver, comprising:

a first local oscillator (elements 5, 12, 14, 15A, and 13 in combination constitute an oscillator [a device for producing alternating current]) for generating an oscillation output having a frequency of f_{p1} (where $2 \cdot \pi \cdot f_{p1} = \omega_4 = \omega_b + \omega_i + 2 \cdot \Delta\omega$);

a second local oscillator (5) for generating an oscillation output having a frequency of f_{p2} (where $2 \cdot \pi \cdot f_{p2} = \omega_l = \omega_b - \omega_i$);

a first multiplier (15B) for multiplying an AM modulation wave desired to be received, by the oscillation output from said first local oscillator (elements 5, 12, 14, 15A, and 13 in combination);

a second multiplier (10M) for multiplying an AM modulation wave desired to be received, by the oscillation output from said second local oscillator (5);

a first low-pass filter (inherently present – see paragraph 10, above) for removing high-frequency components contained in an output of said first multiplier (15B);

a second low-pass filter (inherently present – see paragraph 10, above) for removing high-frequency components contained in an output of said second multiplier (10M);

a subtractor (16) for subtracting an output of said second low-pass filter from an output of said first low-pass filter,

wherein f_c ($2 \cdot \pi \cdot f_c = \omega_{u+} = \omega_b + \Delta\omega$) is a carrier frequency of an interference AM modulation wave causing neighboring interference, $f_{p1} > f_{p2}$ ($[\omega_b + \omega_i + 2 \cdot \Delta\omega] > [\omega_b - \omega_i]$), and $f_{p1} - f_c = f_c - f_{p2}$ ($[\omega_b + \omega_i + 2 \cdot \Delta\omega] - [\omega_b + \Delta\omega] = [\omega_b + \Delta\omega] - [\omega_b - \omega_i] = \omega i + \Delta\omega$).

While Sato et al. does not disclose that the AM modulation wave desired to be received is an AM stereo modulation wave, it was well known in the art at the time the present invention was made to apply an AM stereo modulation wave to an AM receiver. The invention will perform the identical function (with respect to eliminating neighboring-channel interference) with an AM stereo modulation

wave applied as compared to a non-stereo AM modulation wave, and no new or unexpected result is obtained by application of a stereo AM signal. Also, Sato et al. do not disclose a low-pass filter for receiving an output of said subtractor and having a cut-off frequency of $f_c/2$; however as described above regarding claim 1, it was notoriously well known in the art at the time the present invention was made to provide bandpass filtering in intermediate-frequency (IF) amplifiers, such as medium-frequency amplifier 2. Such bandpass filters are typically designed to have a passband that extends slightly beyond the limits of the desired signal band. From Fig. 3D of Sato et al. (Fig. E5-bottom, above), it is apparent that desirable corner frequencies for a bandpass filter to remove the undesired images of the desired signal (centered at $\omega_i \pm 2 \cdot \Delta\omega$) are $\omega_i \pm \Delta\omega$ (midway between the edges of the desired signal component and the undesired image components). Also, it was well known in the art at the time the present invention was made to construct a bandpass filter by cascading a low-pass filter having a cut-off frequency equal to the upper passband corner frequency with a high-pass filter having a cut-off frequency equal to the desired lower passband corner frequency. It would have been obvious to one of ordinary skill in the art at the time the present invention was made to set these corner frequencies accordingly, using a low-pass filter cascaded with a high-pass filter, as was known in the art. If the center frequency of the desired signal component in this signal happened to be located at $\omega_{u+}/2 - \Delta\omega$ (equivalent to $f_c/2 - f_\alpha$, in Applicant's terms), which is not claimed in the current claim, it would have been obvious to one of ordinary skill in the art at the time the present invention was made to set the cut-off

frequency of the low-pass filter at a frequency of $f_c/2$. Applicant does not indicate any advantage to providing the desired signal at this particular frequency ($f_c/2 - f_\alpha$) in the system output. Absent any evidence of a non-obvious advantage to this relationship, or some new and unexpected result, it would have been obvious to one of ordinary skill in the art to choose any particular relationship between the output signal center frequency and the center frequency of any one of the AM modulation signals input to the system of Sato et al. (such as $\omega_i = \omega_{u-}/3$, $\omega_i = \omega_{u-}/\pi$, $\omega_i = \omega_{u-}/\pi + 27 \cdot \Delta\omega$, $\omega_i = \omega_b/10$, etc.), simply by appropriately selecting the frequency (ω_l) of signal S_l in the system of Sato et al., as an obvious design choice, to produce a particular IF signal frequency as required by an existing IF amplifier, or in order to avoid the prior art.

19. Regarding claim 3, the circuit of Sato et al., modified according to the second solution described above to correct the inconsistencies and omissions of that disclosure (Fig. E3, above), constitutes an AM neighboring interference removing circuit for removing AM neighboring interference of an AM receiver, comprising:

a first local oscillator (5) for generating an oscillation output having a frequency of ($f_{p1} + f_\alpha$) (where $2 \cdot \pi \cdot f_{p1} = \omega_{u-} + \omega_i$ [the sum of the frequency of an undesired signal component located at a frequency below the desired AM signal at ω_b by an amount $\Delta\omega$, as defined above at paragraph 15, and the frequency (ω_i) of the desired signal component in signal S_{0M} and at the output of the subtractor 16], and $2 \cdot \pi \cdot f_\alpha = \Delta\omega$ [the inter-channel frequency interval], since

oscillator 5 produces an oscillation at $\omega_l = \omega_{u-} + \omega_i + \Delta\omega$ [seen by re-arranging the fifth equation under paragraph 15, above, to solve for ω_l]);

a second local oscillator (elements 5, 12, 14, 15A, and 13 in combination constitute an oscillator [a device for producing alternating current]) for generating an oscillation output having a frequency of $(f_{p2} - f_\alpha)$ (where $2 \cdot \pi \cdot f_{p2} = \omega_{u-} - \omega_i$ [the difference of the frequency of an undesired signal component located at a frequency below the desired AM signal at ω_b by an amount $\Delta\omega$, as defined above at paragraph 15, and the frequency (ω_i) of the desired signal component in signal S_{0M} and at the output of the subtractor 16], and $2 \cdot \pi \cdot f_\alpha = \Delta\omega$ [the inter-channel frequency interval, as above, since these elements produce an oscillation at $\omega_4 = \omega_{u-} - \omega_i - \Delta\omega$. [seen by re-arranging the seventh equation under paragraph 15, above, to solve for ω_4]);

a third local oscillator (elements 5, 12, 14, 11A, and 13 in combination constitute an oscillator [a device for producing alternating current]) for generating an oscillation output having a frequency of $(f_{p2} + 3f_\alpha)$ (where $2 \cdot \pi \cdot f_{p2} = \omega_{u-} - \omega_i$ [the difference of the frequency of an undesired signal component located at a frequency below the desired AM signal at ω_b by an amount $\Delta\omega$, as defined above at paragraph 15, and the frequency (ω_i) of the desired signal component in signal S_{0M} and at the output of the subtractor 16], and $2 \cdot \pi \cdot f_\alpha = \Delta\omega$ [the inter-channel frequency interval, as above, since these elements produce an oscillation at $\omega_2 = \omega_{u-} - \omega_i + 3 \cdot \Delta\omega$. [seen by re-arranging the sixth equation under paragraph 15, above, to solve for ω_2]);

a first multiplier (10M) for multiplying an AM modulation wave desired to be received, by the oscillation output from said first local oscillator (5);

a second multiplier (15B) for multiplying an AM modulation wave desired to be received, by the oscillation output from said second local oscillator (elements 5, 12, 14, 15A, and 13 in combination);

a third multiplier (11B) for multiplying an AM modulation wave desired to be received, by the oscillation output from said third local oscillator (elements 5, 12, 14, 11A, and 13 in combination);

a first low-pass filter (inherently present – see paragraph 10, above) for removing high-frequency components contained in an output of said first multiplier (10M);

a second low-pass filter (inherently present – see paragraph 10, above) for removing high-frequency components contained in an output of said second multiplier (15B);

a third low-pass filter (inherently present – see paragraph 10, above) for removing high-frequency components contained in an output of said third multiplier (11B);

a subtractor (16) for subtracting outputs of said second and third low-pass filters from an output of said first low-pass filter,

wherein f_c ($2 \cdot \pi \cdot f_c = \omega_{u-}$) and $f_c + 2f_\alpha$ ($2 \cdot \pi \cdot [f_c + 2f_\alpha] = \omega_{u+} = \omega_{u-} + 2 \cdot \Delta\omega$) are carrier frequencies of interference AM modulation waves causing neighboring interference, being lower and higher by a frequency f_α ($2 \cdot \pi \cdot f_\alpha = \Delta\omega$) from an AM carrier frequency of the AM modulation wave desired to be received, $f_{p1} > f_{p2}$ ([ω_{u-}

$+ \omega_i] > [\omega_{u-} - \omega_i]$), and $f_{p1} - f_c = f_c - f_{p2}$ ($[\omega_{u-} + \omega_i] - \omega_{u-} = \omega_{u-} - [\omega_{u-} - \omega_i] = \omega_i$).

While Sato et al. does not disclose that the AM modulation wave desired to be received is an AM stereo modulation wave, it was well known in the art at the time the present invention was made to apply an AM stereo modulation wave to an AM receiver. The invention will perform the identical function (with respect to eliminating neighboring-channel interference) with an AM stereo modulation wave applied as compared to a non-stereo AM modulation wave, and no new or unexpected result is obtained by application of a stereo AM signal. Also, Sato et al. does not explicitly disclose a bandpass filter for receiving an output of said subtractor and having a bandpass frequency in a range from $(f_c/2 - f_\alpha)$ to $(f_c/2 + f_\alpha)$; however as described above regarding claim 1, it was notoriously well known in the art at the time the present invention was made to provide bandpass filtering in intermediate-frequency (IF) amplifiers, such as medium-frequency amplifier 2. Such bandpass filters are typically designed to have a passband that extends slightly beyond the limits of the desired signal band. From Fig. 3D of Sato et al. (Fig. E5-bottom, above), it is apparent that desirable corner frequencies for a bandpass filter to remove the undesired images (centered at $\omega_i \pm 2 \cdot \Delta\omega$) of the desired signal (centered at ω_i) are $\omega_i \pm \Delta\omega$ (midway between the edges of the desired signal component and the undesired image components). Thus one of ordinary skill in the art would provide a passband in the bandpass filter(s) of the medium-frequency amplifier (2) that is in a range from $(\omega_i - \Delta\omega)$ to $(\omega_i + \Delta\omega)$. Obviously, the limitation making this bandwidth equal to $(f_c/2 - f_\alpha)$ to

$(f_c/2 + f_\alpha)$ $[(\omega_{u\text{-}}/2 - \Delta\omega)$ to $(\omega_{u\text{-}}/2 + \Delta\omega)]$ means making the center of the passband of the bandpass filter(s) equal to $f_c/2$, which in turn means setting the frequency of the desired signal in the output of the system equal to one-half the frequency of the lower-frequency interfering signal ("f_c" to Applicant, "$\omega_b - \Delta\omega$" to Sato et al., and "$\omega_{u\text{-}}$" according to the examiner's definition); that is, setting $\omega_i = \omega_{u\text{-}}/2$. Applicant does not indicate any advantage to providing the desired signal at this particular frequency in the system output. Absent any evidence of a non-obvious advantage to this relationship, or some new and unexpected result, it would have been obvious to one of ordinary skill in the art to choose any particular relationship between the center frequency of the system output signal and the center frequency of any one of the AM modulation signals input to the system of Sato et al. (such as $\omega_i = \omega_{u\text{-}}/3$, $\omega_i = \omega_{u\text{-}}/\pi$, $\omega_i = \omega_{u\text{-}}/\pi + 27 \cdot \Delta\omega$, $\omega_i = \omega_b/10$, etc.), simply by appropriately selecting the frequency (ω_l) of signal S_l in the system of Sato et al., as an obvious design choice, to produce a particular IF signal frequency as required by an existing IF amplifier, or in order to avoid the prior art.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tony M Jacobson whose telephone number is 703-305-5532. The examiner can normally be reached on M-F 11:00-7:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Forester W Isen can be reached on 703-305-4386. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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October 4, 2004

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PRIMARY EXAMINER